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SVM based Multispectral Remote Sensing Image Analysis

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ABSTRACT

Methods of Detection of Multi spectral remote sensing Images are becoming more popular due to the progresses in spatial resolution of satellite imagery. This paper presents detection of multispectral remote-sensing images corrupted by noise using Support Vector Machines. First enhancement of color separation of satellite image using decorrelation stretching is carried out and then the regions are grouped into a set of classes using Support Vector Machines. Simulation results are provided to demonstrate the efficacy of the proposed method for detection of Multi spectral remote sensing Images.

Key Words— Decorrelation, LANDSAT imagery, Spatial resolution, Support Vector Machines.

I. INTRODUCTION

The process of image segmentation (such as pixel based, contour based, region based, model based, color based and hybrid, etc.) is defined as the search for homogenous regions in an image and later the classification of these regions. It also means the partitioning of an image into meaningful regions based on homogeneity or heterogeneity criteria [1]. Multispectral image delivers a great source of data for studying spatial and temporal changeability of the environmental factors. It can be utilized in a number of applications which consists of reconnaissance, making of mapping products for military and civil use, assessment of environmental damage, nursing of land use, radiation level check, urban planning, growth directive, soil test and crop outcome increment . One major area where we use multispectral image is in the process of classification and mapping of vegetation over large spatial scales, as the remote sensing data delivers very good coverage, mapping and classification of land cover features like vegetation, soil, water and forests. This behaves like a replacement for the normal classification techniques, which necessitates expensive and time-intensive field surveys.

Purposes of classification of LANDSAT images is to identify Land use and land cover (LULC) Vegetation types, Geologic terrains, Mineral exploration, Alteration mapping, etc. LANDSAT 7 was launched in April, 1999. LANDSAT carries two multispectral sensors. The first is the *Multi-Spectral Scanner* (MSS) which acquires imagery in four Spectral bands: blue, green, red and near infrared. The second is the *Thematic Mapper* (TM) which collects seven bands: blue, green, red, near-infrared, two mid-infrared and one thermal infrared. The MSS has a spatial resolution of 80 meters, while that of the TM is 30 meters. Both sensors image a 185 km wide swath, passing over each day at 09:45 local time, and returning every 16 days. With LANDSAT 7, support for TM, imagery is to be continued with the addition of a co-registered 15 m panchromatic band [4].

Multispectral image classification can be considered as a combined project of both image processing and classification methods. Usually, image classification, in the process of remote sensing is the method of referring pixels or the basic units of an image to the

classes. It is mostly likely to create groups of similar pixels found in image data into classes that match the informational categories of user interest by matching the pixels to one another and to those of the said identity. Many techniques of image classification have been introduced and numerous areas like image analysis and pattern recognition use the vital term, classification.

Image segmentation is a process of partitioning image pixels based on selected image features. The pixels that belong to the same region must be spatially connected and have the similar image features. If the selected segmentation feature is color, an image segmentation process would separate pixels that have distinct color feature into different regions, and, simultaneously, group pixels that are spatially connected and have the similar color into the same region.

Classification of multispectral remotely sensed data is computed with a special attention on uncertainty computation in the land-cover maps. An efficient technique for classifying the multispectral satellite images into land cover and land use sectors using SVM. The proposed classification technique comprises of segmentation using clustering technique, training data selection for SVM and classification using trained SVM. Multispectral images cannot be fed directly into the SVM for training and testing. The input image is subjected to a set of pre-processing so that the image gets transformed suitably for segmentation.

This paper deals with statistical cluster analysis in the potential presence of contaminations. Detection of multispectral remote-sensing images corrupted by noise using Support Vector Machines is proposed in this paper.. Simulation results are provided to demonstrate the effectiveness of proposed algorithm.

I. Proposed Pixel Analysis with SVM

Support Vector Machines (SVM) [16] is a statistical learning based classification system. The SVM sections the classes with respect to a decision surface that maximizes the margin between the classes. The surface is normally known as the optimal hyperplane and the data points closest to the optimal hyperplane are known as the support vectors. These support vectors are the most important elements of the training set. Some deviations of SVM are: 1) the SVM can be modified to make it a nonlinear classifier by the employment of nonlinear kernels and 2) a multiclass classifier can be made by clubbing a large number of binary SVM classifiers (making a binary classifier for every possible pair of classes). For multiclass classification, the pair wise classification strategy is regularly made use of. The result of the SVM classification is the decision values of each pixel for each of the class.

The learning set $D = \{(x_i, y_i)\}_{i=1}^{n}$ is given as input to a binary SVM classifier. The latter is among the most popular supervised kernel-based classifiers available in the literature. Compared to standard classification methods, it relies on the margin maximization principle that makes it less sensitive to over fitting problems [11]. During the classification stage, a spectral-change map is generated by classifying the remaining pixels in the DI as change or no change. The decision for assigning each pixel is made according to the following decision unction:

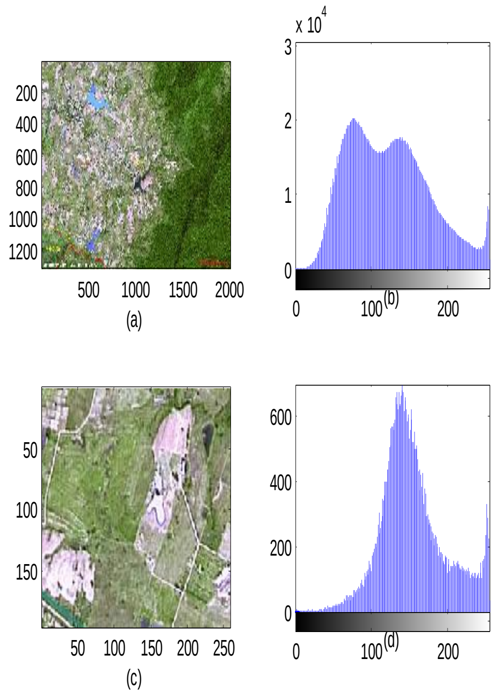
$$f(x)= \sum_{i \varepsilon S} \alpha_i y_i K(x_i, x) + b^* \quad (3)$$

where $K(.,.)$ is a kernel function.

The set S is a subset of the indices {1,2,……,n} corresponding to the nonzero Lagrange multipliers α_i 's which define the so-called support vectors, and b^* is the ambient noise.

II. Simulation Results

Various experiments were carried out using SVM based image analysis for LANDSAT images and results are summarized in Fig1 to Fig 4. In Fig 5, error analysis of the proposed SVM method is shown and these results demonstrate that multispectral remote sensing image corrupted with noise analysis can be carried out with to maximum accuracy.



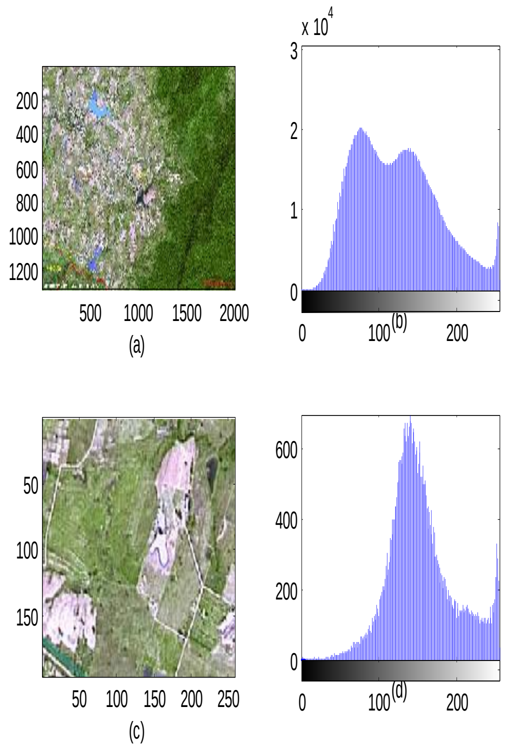


Fig1.(a) & (b) Original Image & its Histogram, (c) & (d) Decoorelated Image & its Histogram

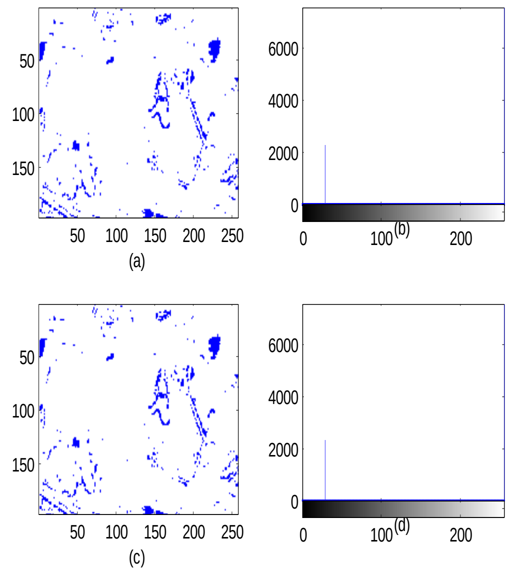


Fig2.(a) & (b) Objects in cluster 1 (multi spectral remote sensing Image without noise is considered) & its Histogram, (c) & (d) Objects in cluster 1 (multi spectral remote sensing Image with noise is considered) & its Histogram.

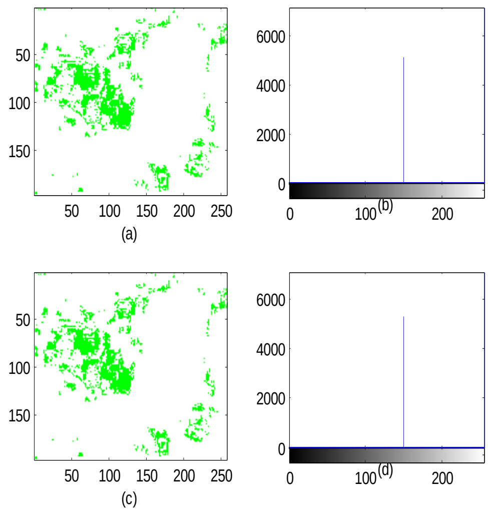


fig 3.(a) & (b) Objects in cluster 2 (multi spectral remote sensing Image without noise is considered) & its Histogram, (c) & (d) Objects in cluster 2 (multi spectral remote sensing Image with noise is considered) & its Histogram.

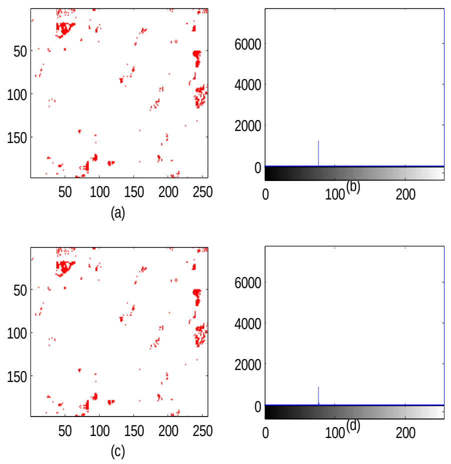


fig 4. (a) & (b) Objects in cluster 3 (multi spectral remote sensing Image without noise is considered) & its Histogram, (c) & (d) Objects in cluster 3 (multi spectral remote sensing Image with noise is considered) & its Histogram.

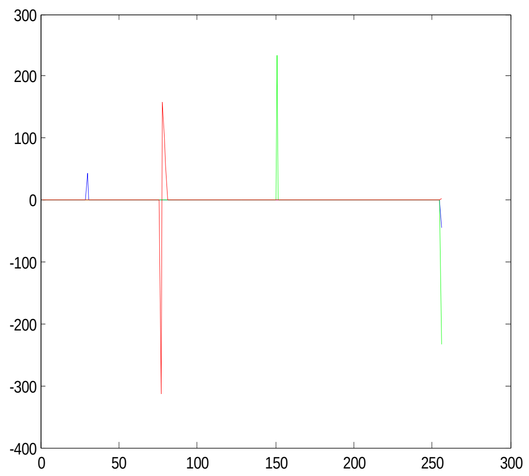


Fig5. Error Analysis for the considered 3 clusters (Blue, Green, Red indicates cluster 1, cluster 2 and cluster3, respectively).

IV. CONCLUSIONS

In this paper, SVM based algorithm for detection of Multi Spectral Remote sensing Images corrupted with noise is proposed analyzed. Simulation results are also provided, which demonstrate the efficiency of proposed algorithm for image analysis for extracting and updating geographical information though considered LANDSAT Images are corrupted with noise.

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